

REMARKS

In the Office Action mailed April 2nd, 2007, the Examiner took the following action: (1) objected to claims 14-28 due to informalities in claim 14; (2) objected to the drawings under 37 CFR 1.83(a); (3) rejected claims 1, 7, 8, and 13 under 35 U.S.C. §102(b) as being anticipated by Huffman (US 3169200); (4) rejected claims 1, 7, 8, and 13 under 35 U.S.C. §102(e) as being anticipated by Tavkhelidze *et al.* (US 6720704); (5) rejected claims 2-4 and 12 under 35 U.S.C. §103(a) as being unpatentable over Tavkhelidze in view of Martinovsky *et al.* (US 6876123); (6) rejected claims 5, 6, 9, 14, 18-24, and 28 under 35 U.S.C. §103(a) as being unpatentable over Tavkhelidze in view of Caldwell (US 3515908); (7) rejected claims 10 and 11 under 35 U.S.C. §103(a) as being unpatentable over Tavkhelidze in further view of Yater (US 4004210); (8) rejected claims 15-17 and 27 under 35 U.S.C. §103(a) as being unpatentable over Tavkhelidze and Caldwell, in view of Martinovsky; (9) rejected claims 25 and 26 under 35 U.S.C. §103(a) as being unpatentable over Tavkhelidze and Caldwell, in view of Yater. Applicant respectfully requests reconsideration of the application in view of the foregoing amendments and the following remarks.

I. Objections to the Drawings and Objections to the Claims

The Examiner objected to the drawings on grounds that the drawings must show every feature of the invention recited in the claims. The Examiner objected to claims 14-28 due to informalities noted by the Examiner in claim 14.

Applicant has amended claim 14 to correct the informality noted by the Examiner. Accordingly, Applicant respectfully requests reconsideration and withdrawal of the objection to claims 14-28, and the object to the drawings which is based on the informality noted in claim 14 which has now been corrected.

II. Rejections under 35 USC §102(b), §102(e), and §103(a)

Claims 1-13

As amended claim 1 recites:

1. A solid state thermal engine device for converting thermal energy into an electric current, the device including one or more thermal tunneling units, the one or more thermal tunneling units comprising:
 - a first metal electrode; and
 - a second metal electrode mated to the first metal electrode,wherein an effective gap is formed between the first and second metal electrodes on the order of one nanometer,
wherein the effective gap is formed by applying at least one of a voltage and a current across the mated electrodes to provide a rearrangement of a polycrystalline structure of the mated electrodes.
(emphasis added).

Huffman (US 3169200)

Huffman teaches a “thermotunnel converter” having first and second electrodes separated by a “gap” of up to 40 (e.g. 5 – 40) angstroms. (1:50-51; 4:33-34; 2:55; 5:12). According to Huffman, the “gap” is filled with an oxide spacer. (2:57; 3:3) Huffman is silent, however, as to the manner in which the “gap” is formed. There is especially no teaching or suggestion of an “*effective gap is formed by applying at least one of a voltage and a current across the mated electrodes to provide a rearrangement of a polycrystalline structure of the mated electrodes*” as recited in claim 1.

Tavkhelidze (US 6720704)

Tavkhelidze teaches thermoionic devices or “gap diodes” having electrodes separated by a separation of sub-micron sizes, and maintained at this small distance using

piezo-electric, electrostrictive, or magnetostrictive actuators. (7:1-3). The separation may be sized “on the order of tens of angstroms.” (9:49). According to Tavkhelidze, the separation is formed by MEMS devices. (7:49-50). There is no teaching or suggestion of an “*effective gap is formed by applying at least one of a voltage and a current across the mated electrodes to provide a rearrangement of a polycrystalline structure of the mated electrodes*” as recited in claim 1.

Martinovsky et al. (US 6876123)

Martinovsky teaches a thermotunnel converter having a gap between electrodes, the gap being formed on the order of 40 angstroms. (3:7-8). According to Martinovsky, the gap is formed by successively layering a “removeable material” on a first electrode, then forming a second electrode on the layers of removeable material, and then removing the removeable material, such as by sublimation or evaporation. (3:33-46; 4:55-56). There is no teaching or suggestion of an “*effective gap is formed by applying at least one of a voltage and a current across the mated electrodes to provide a rearrangement of a polycrystalline structure of the mated electrodes*” as recited in claim 1.

Caldwell (US 3515908)

Caldwell teaches a thermoionic converter having two substrates bonded together, and two electrodes separated by a recess 21 and maintained by spacers 25. (3:38-53). Caldwell is silent as to the manner in which the “recess” is formed. There is especially no teaching or suggestion of an “*effective gap is formed by applying at least one of a voltage and a current across the mated electrodes to provide a rearrangement of a polycrystalline structure of the mated electrodes*” as recited in claim 1.

Yater (US 4004210)

Yater teaches thermoelectric converters having modules 7 and conversion modules 8 separated by a thermal barrier 2 or vacuum. (3:35-45). The barrier 2 is maintained by spacers 47. (3:48). Yater is silent as to the manner in which the “recess” is formed. There is especially no teaching or suggestion of an “*effective gap is formed by applying at least one of a voltage and a current across the mated electrodes to provide a rearrangement of a polycrystalline structure of the mated electrodes*” as recited in claim 1.

Applicant respectfully submits that the Cited References (Huffman, Tavkhelidze, Martinovsky, Caldwell, and Yater), either singly or in combination, fail to disclose, teach, or fairly suggest the device recited in claim 1. Specifically, in relevant part, claim 1 recites a first metal electrode, a second metal electrode, a gap between the first and second metal electrodes, wherein the “*effective gap is formed by applying at least one of a voltage and a current across the mated electrodes to provide a rearrangement of a polycrystalline structure of the mated electrodes.*” The Cited References teach other ways of forming a gap, or are silent on the subject of how the gap is formed. There is not teaching or suggestion in the Cited References of the above-recited limitation as disclosed by Applicant. Accordingly, claim 1 is allowable over the Cited References. Claims 2-13 depend from claim 1 and are also allowable at least due to their dependencies on claim 1, and also due to additional limitations recited in those claims.

Claims 14-28

As amended, claim 14 recites:

14. A solid state thermal engine device for converting thermal energy into an electric current, the device comprising:
a first wafer portion including:
a first surface; and

a first metal electrode attached to the first surface; and
a second wafer portion including:
a second surface; and
a second metal electrode attached to the ~~first~~ second surface; the first surface of the first wafer portion being bonded to the second surface of the second wafer portion, and the first metal electrode of the first wafer portion is mated to the second metal electrode of the second wafer portion, such that an effective gap on the order of one nanometer is formed between the metal electrodes,
wherein the effective gap is formed by applying at least one of a voltage and a current across the mated electrodes to provide a rearrangement of a polycrystalline structure of the mated electrodes. (emphasis added).

As described more fully above, Applicant respectfully submits that the Cited References (Huffman, Tavkhelidze, Martinovsky, Caldwell, and Yater), either singly or in combination, fail to disclose, teach, or fairly suggest the device recited in claim 14. Specifically, claim 14 recites, in relevant part, a first metal electrode, a second metal electrode, a gap between the first and second metal electrodes, wherein the “*effective gap is formed by applying at least one of a voltage and a current across the mated electrodes to provide a rearrangement of a polycrystalline structure of the mated electrodes.*” The Cited References teach other ways of forming a gap, or are silent on the subject of how the gap is formed. There is not teaching or suggestion in the Cited References of the above-recited limitation as disclosed by Applicant. Accordingly, claim 14 is allowable over the Cited References. Claims 15-28 depend from claim 14 and are also allowable at least due to their dependencies on claim 14, and also due to additional limitations recited in those claims.

For the foregoing reasons, Applicant respectfully requests reconsideration and withdrawal of the rejections of claims 1-28.

CONCLUSION

Applicant respectfully submits that pending claims 1-28 are now in condition for allowance. If there are any remaining matters that may be handled by telephone conference, the Examiner is kindly invited to contact the undersigned attorney at the telephone number listed below.

Respectfully Submitted,

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